Space Weather Technical Forecast

Issued on Monday, 10 April 2023 at 01:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-class flares (R1-R2 Minor-Moderate radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Low with a peak flare of C9.1 09/0609 UTC emanating from AR3272 in the southeast quadrant which has developed into a Fai/βγ region. A further rapidly developing region in the northeast quadrant has been numbered as AR3273. A small simple region close to centre disc is unnumbered, as is a further region towards the northeast limb. A number of recent eruptions have been modelled as being off the Earth-Sun line, but a recent eruption from the southwest quadrant will be analysed once further data becomes available.

Solar Wind / Geomagnetic Activity: Solar wind speed as measured by ACE at L1 was at background below 350km/s throughout. Density was also below average, resulting in anomalous readings from DSCOVR. Total magnetic field strength was weak for much of the period, but increased to 9nT towards the end of the period, possibly due to a stealth CME. The north-south magnetic field has varied weakly, but was persistently, weakly negative from 09/1800UTC. Phi angle was generally negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV), as measured at GOES16, was at background. The high energy electron flux (greater than 2MeV), as measured at GOES16 started at Moderate levels, but was high between 09/1230UTC and 09/1950UTC, reaching a high peak of 1850pfu at 09/1600UTC. The associated 24 hour fluence was below the Active threshold. The 09/0000 UTC observed fluence was 6.755e7 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Mainly Low with isolated Moderate levels of activity are expected, mainly due to AR3272 in the southeast quadrant.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs, with a low possibility of a glancing blow either late on 11 or early on 12 Apr. A filament eruption from the southwest of the Sun late on 09 April will be analysed as further data becomes available. A stealth CME may also affect the Earth early on 10 Apr due to recent data. A high speed stream from coronal hole 91 is forecast to connect with Earth on 11 Apr, with speeds of 500km/s considered possible. Geomagnetic activity is expected to be mainly Quiet to Unsettled, with a slight chance of Active or G1/Minor Storms possible.

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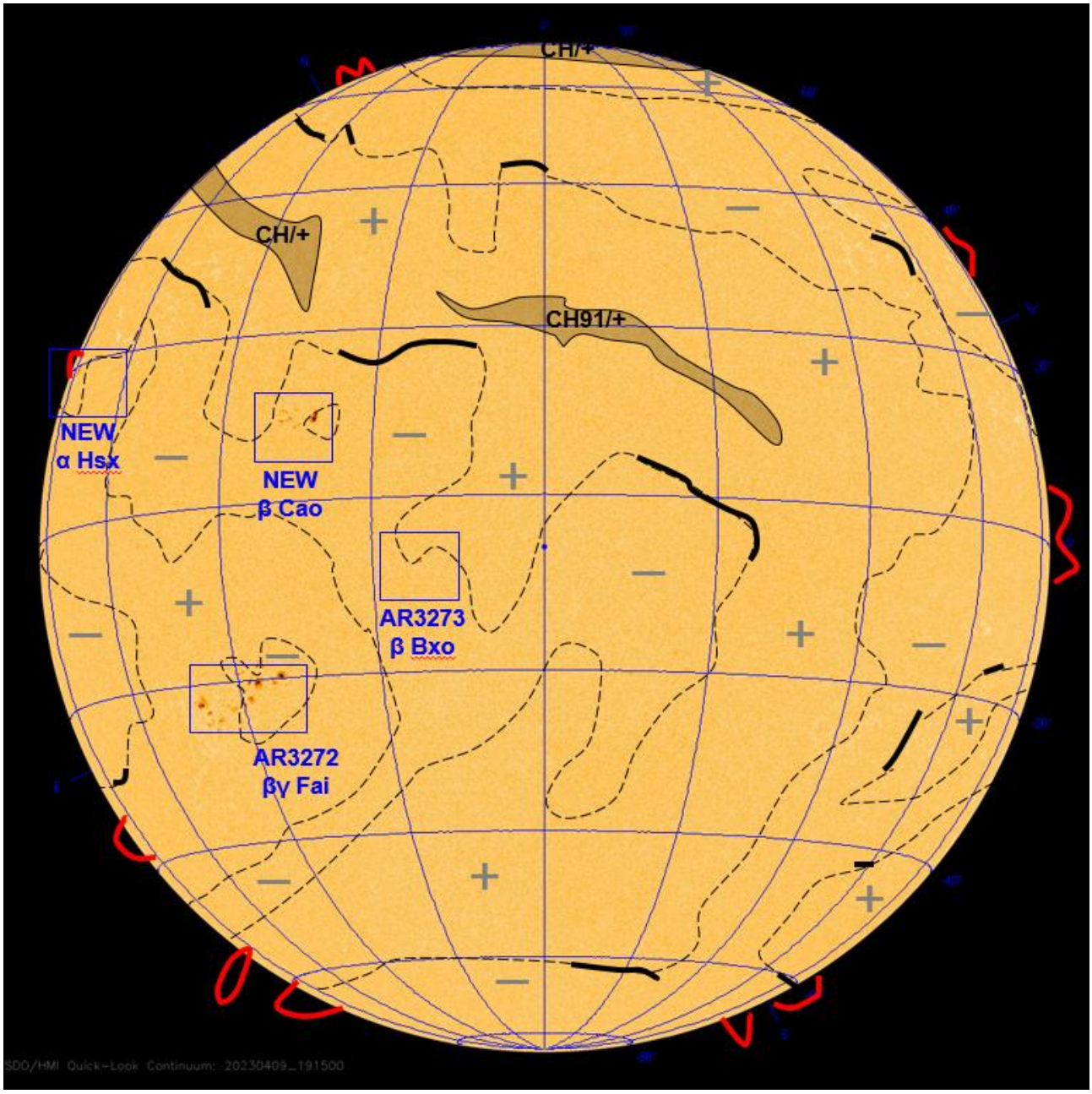
Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to persist at background levels. High energy (greater than 2 MeV) electron flux is likely to initially follow a declining trend in peak values, with a more significant drop due to any geomagnetic activity on 11 Apr. A recovery in values is then possible on 12 or 13 Apr. Electron fluence is forecast to follow a downward trend through much of the period, with a slight increase towards the Active threshold by 13 Apr.

Figure 1. Solar Analysis Valid 09/2000UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs are expected, but a slight glancing blow is possible either late on 11 Apr or during 12 Apr due to a CME from 07 Apr, although this is considered to be a low possibility. A stealth CME appears to have arrived at Earth late on 09 into 10 Apr and any effects will be monitored.

Otherwise the Earth is under background solar wind speeds with no high speed stream connections observed. The high speed stream from positive coronal hole 91 is then forecast to connect with Earth on 11 Apr. This is an elongated feature, with much of the coronal hole hidden by magnetic looping. Once connected this is likely to remain so for the remainder of the period, giving estimated speeds of 500km/s. As this is a positive polarity hole, it is not favoured for a strong connection close to the March equinox.

Geomagnetic activity is expected to be mainly Quiet to Unsettled through the period. There is a very slight chance of Active or G1/Minor Storm intervals through 11 and 12 Apr due to the potential CME arrival.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
08/0107	Partial	Filament	SW	388km/s	12/0000UTC	Very low risk of glancing blow

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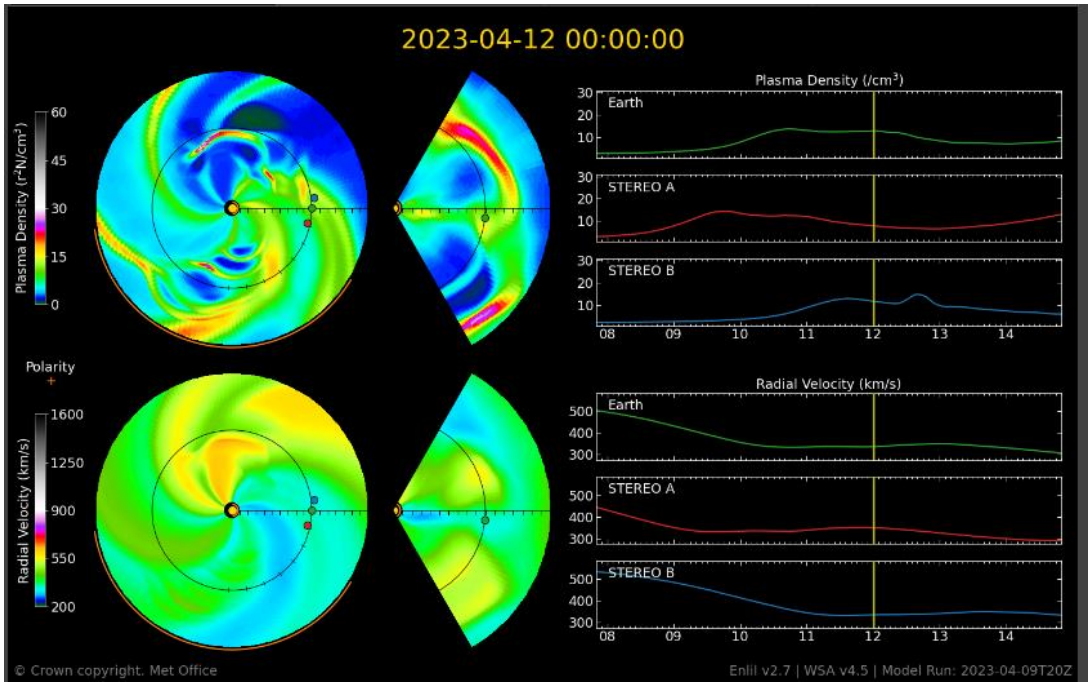
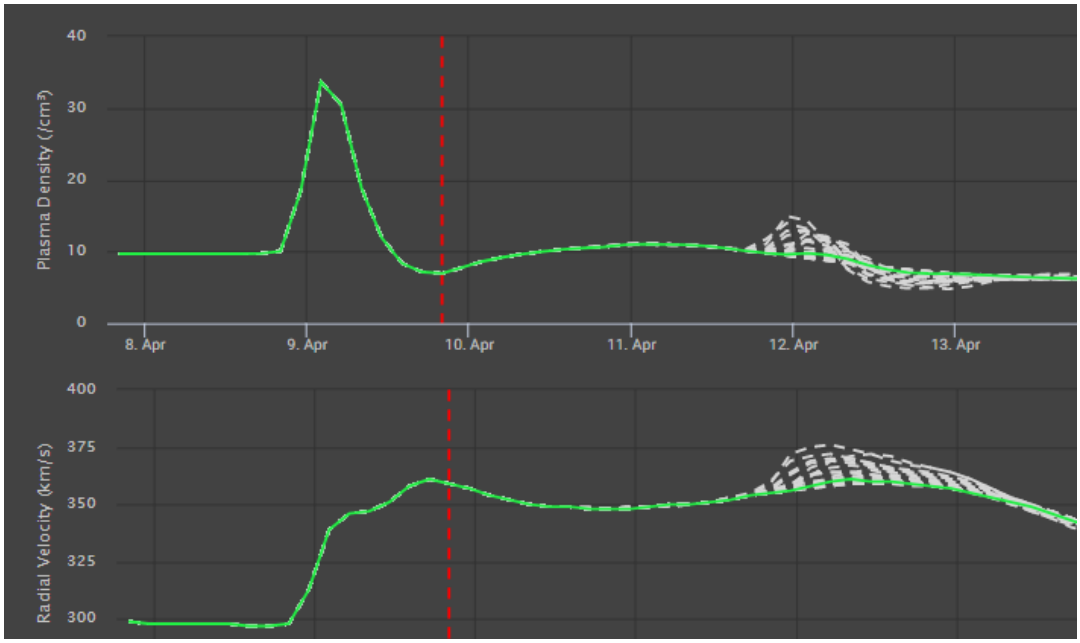
Figure 2: MOSWOC Enlil output showing time of potential glancing CME blow, with associated MOSWOC Enlil ensemble below.





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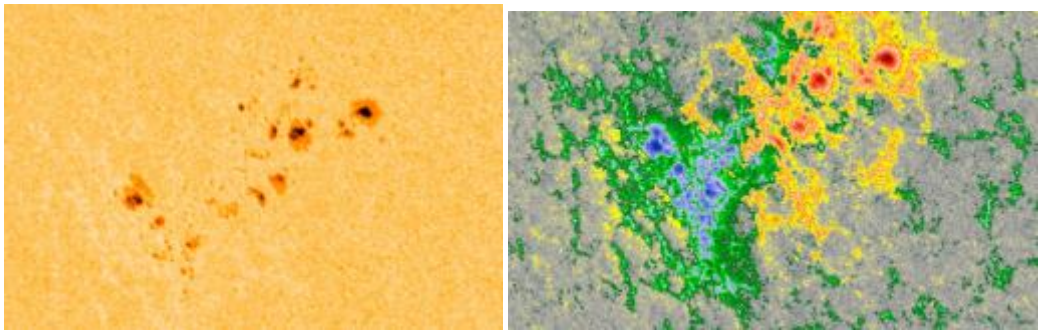
Radio Blackouts - X-Ray Flares:
Mainly Low activity is expected through the next four days, with slight rises to Moderate, mainly due to the effects of AR3272 in the southeast quadrant.

AR3272 is a complex region which as spread further to be classified as a Fai/βγ region. This has elevated the risk of M-class flares, with a significant level of flux across the region. The remaining regions on the visible disc all appear simple and benign, although a new region on the northeast limb may reveal more complexity as it rotates further into view. A large area of flux, just beyond the southeast limb also has to potential to be linked to a complex sunspot region.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: SDO HMI intensitygram and magnetogram imagery of AR3272 in the southeast quadrant



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV), as observed by GOES-16, is currently expected to remain at background through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) observed at GOES-16 is forecast to be mainly Moderate, with peaks above the high (1000 pfu) on diurnal peaks. The onset of the next high speed stream on 11 Apr could lead to an initial drop in electron flux, due to any geomagnetic activity, followed by increase in the magnitude of these peaks through 12 and 13 Apr, as additional electrons are added to the radiation belts and solar winds slowly ease.

24-hour fluence values are expected to follow a steadily declining trend through 10 and 11 Apr, but may then rise from later on 12 Apr as any geomagnetic activity from either CME arrivals or high speed stream connections on 11 or 12 Apr subside.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	10	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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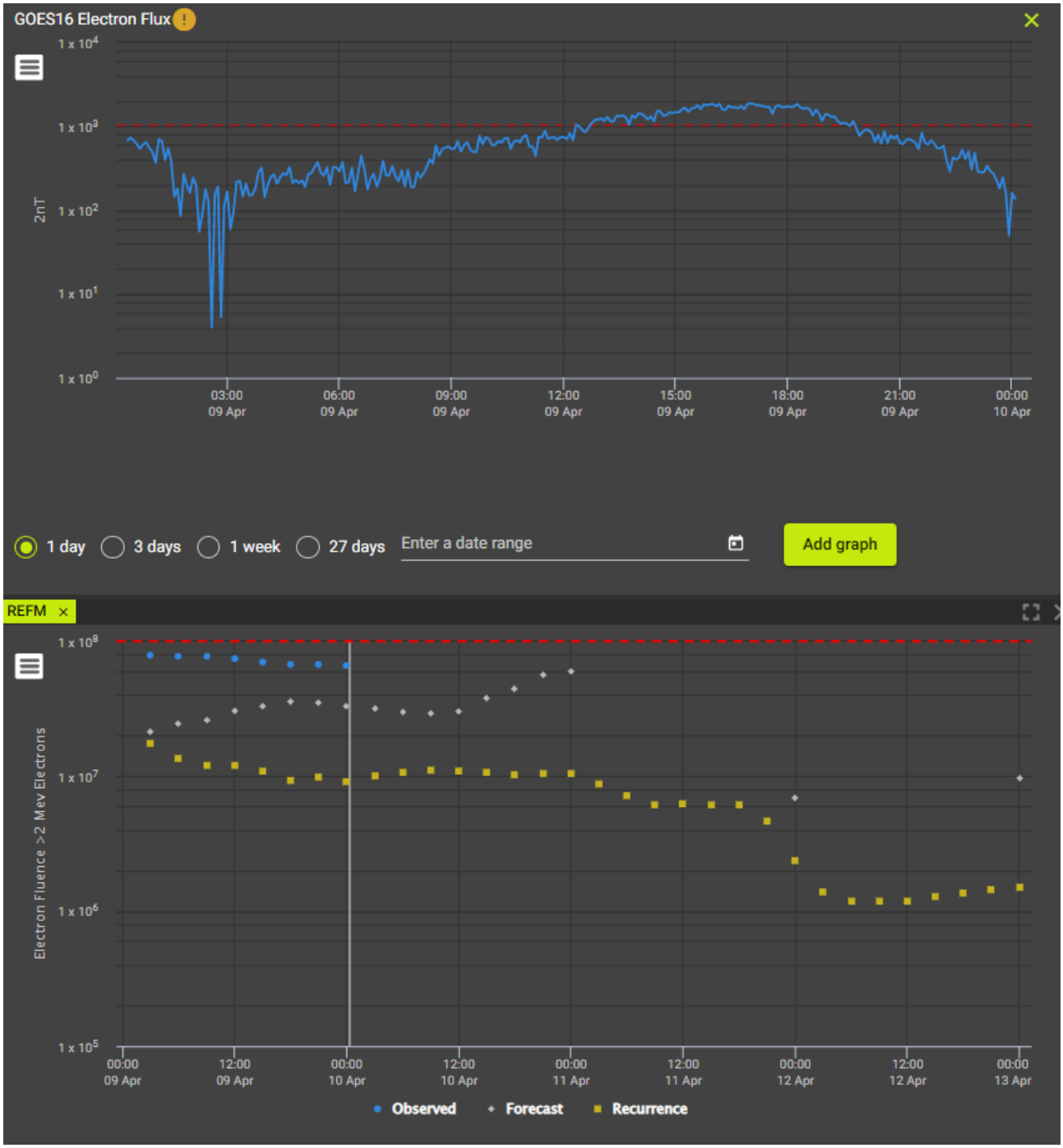
Figure 4: GOES 16 electron flux and MOSWOC REFM model



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